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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/644,356	08/19/2003	Tsai-Sheng Gau	67,200-1053	8900

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EXAMINER

BARRECA, NICOLE M

ART UNIT	PAPER NUMBER
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1756

DATE MAILED: 03/27/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

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Office Action Summary	Application No.	Applicant(s)	
	10/644,356	GAU ET AL.	
	Examiner	Art Unit	
	Nicole M. Barreca	1756	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 09 January 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-8, 10-19 and 25-31 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-8, 10-19 and 25-31 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|-----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

1. Claims 1-8, 10-19, 25-31 are pending in this application.

Claim Objections

2. Claim 28 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. Claim 15 already recited an etchback process produces via plugs partially filling vias.
3. Claim 16 is objected to because of the following informalities: claim 16 appears to be a duplicate of claim 4. Was claim 16 intended to be dependent on claim 15, instead of claim 1? Appropriate correction is required.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claim 26 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 26 is unclear in the recitation that the etch process produces via plugs partially filling vias formed in a dielectric layer. Claim 1 did not previously recite the presence of vias or a dielectric layer.

Claim Rejections - 35 USC § 103

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6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. Claims 1, 2, 4-8, 10-13, 15-19, 25-31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sato (US 6,064,466) in view of Beyer (US 4,33,794).

8. The invention is based on the relationship between subresolution and pattern density and resist thickness. A high pattern density minimizes the radiation that passes through a pattern mask. As the pattern density increases less actinic light is allowed through. The current system includes a multiple density portion pattern mask which is placed over the resist-coated substrate (col.1, 49-63). An exposure mask is adapted to account for surface irregularities of a wafer's surface in order to improve planarization. The value for the residual resist thickness depends on the light intensity, pattern density, development time and type of resist used. The initial resist thickness is T (initial) (i.e. determining the first thickness). Semiconductor substrate 10 with (topography) feature 11, such as a line and space pattern, is coated with a layer of resist 12. A mask 15 with different light transmittance portion is aligned with the feature and a radiation source exposes the resist through the mask. The exposed resist is developed. The mask allows less than the full intensity radiation to fall upon some regions of the resist and therefore less resist is removed. After development the surface of the resist 22 over feature 11 and that over substrate 10 are equalized (thickness topography altered). Further the coating, exposing and developing steps

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may be repeated to further planarize the surface of the wafer. See col.2, 59-col.4, 2. and Figures 4A-E. The substrate may also have a narrow pit or indentation 31 (col.4, 3-25, Figures 5A-D). Mask of Figure 6A includes a simple opaque portion 34 and intermediate transmittance portions, such as subresolution pattern and portion 39 (col.4, 26-61). Semiconductor wafer 43 includes multiples trenches 41. This equates to a low pattern density over the non-trenched region and a high pattern density over the trenched region (i.e. first and second density). The mask portion above the thickest portion of the resist has the highest light transmittance. The level of the resist may be reduced to levels 44 (thickness portion covering and filling the vias) and/or 45 preparing the substrate for the next level of processing (col.4, 62-col.5, 33, Figures 7A-C).

9. Sato teaches that the above process may also be used to reduce the resist layer in the openings to a level below the substrate surface by adjusting the exposure time or mask transmittance. The reference does not disclose the method to further include an additional step of an etch process to produce a third thickness topography or an etchback to produce plugs filling the vias. Beyer teaches that it is conventional in the art to use an oxygen plasma etchback in order to fill and protect trenches with a resist plug (col.11, 6-15). It would have been obvious to one of ordinary skill in the art to use an etchback process to reduce the resist layer thickness and form via plugs in the method of Sato, instead of adjusting the exposure time or mask transmittance, because Beyer teaches that such an etchback process is conventional and known in the art and with the expectation that such a process while processing similar results would require an additional process step.

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10. Sato teaches that the wafer includes multiple trenches openings with variable pattern density and does explicitly recite that these openings are vias as recited in claim

15. However trench openings and via openings are both conventionally found in the photolithography and semiconductor manufacturing art and their individual use would be dependent on the final device being manufactured. It would have been obvious to one of ordinary skill in this art that the planarization method taught in Sato would be the same regardless of the name given to such openings.

11. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sato in view of Beyer as applied to claim 1 above, and further in view of Lewis (US 4,822,722).

12. Sato is silent on the method used to measure the initial resist thickness. Lewis teaches that the thickness of a photoresist layer is known to be measured using interferometry, profilometry and elipsometry (col.6, 34-44). It would have been obvious to one of ordinary skill in the art to use interferometry, profilometry or elipsometry to measure the initial resist thickness in the method of Sato in view of Beyer because Lewis teaches that these are all known suitable methods of resist thickness measurement.

13. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sato in view of Beyer as applied to claim 1 above, and further in view of Aronsatein (US 3,889,355).

14. Sato teaches exposing the photoresist by aligning a mask but is silent on the specific exposure method used. Aronsatein teaches that conventional resist exposure systems include contact printing, projection printing and step and repeat techniques

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(col.10, 3-10). It would have been obvious to one of ordinary skill in the art to expose the resist in the method of Sato in view of Beyer using contact, projection or step and repeat techniques because Lewis teaches that these are all known conventional resist exposure systems.

Response to Arguments

15. Applicant's arguments with respect to the claims have been considered but are moot in view of the new ground(s) of rejection. Since the same references have been used however, pertinent arguments will be addressed.

16. The applicant argues that Sato does not disclose a first and second density of features, such as vias. This has been addressed in the preceding rejection. See also Fig. 7(b). Sato discloses determining an photoresist thickness T (initial), addressing the argument that the reference does not determine a first thickness. The limitation of performing an etch process is newly added to the independent claim and is addressed in the new 103 rejection. The applicant argues that Sato does not teach that the exposure is a higher dosage to an area of the polymer overlying the second density. See col.1, 49-57. The applicant argues that Sato does not disclose developing so that a planarized thickness comprises a thickness portion above and covering the vias. See col. 5, 29-32 and Fig. 7(c) which teaches that the resist level is reduced to level 44 (above substrate).

17. With respect to claim 25, the applicant states that the examiner states that Sato does not disclose determining a thickness of the resist layer. This is **not** what was stated by the examiner. Paragraph 7 of the office action mailed 10/4/05 states that

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"Sato does not disclose **repeating the steps of determining the initial thickness** through development." Sato teaches determining the initial thickness and repeating the coating, exposing and developing, as addressed in the rejection. Additionally as amended claim 25 no longer recites the steps of determining "an initial" thickness topography is repeated.

18. In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

19. With respect to claim 3, in response to applicant's argument that the examiner's conclusion of obviousness is based upon improper hindsight reasoning, it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971).

20. With respect to claim 14, in response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re*

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Keller, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

21. The applicant argues that there is no motivation for combining Sato with Breyer. In response to applicant's argument that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, the motivation is found in the references themselves, in this case Beyer. In response to applicant's argument that the references are nonanalogous art, it has been held that a prior art reference must either be in the field of applicant's endeavor or, if not, then be reasonably pertinent to the particular problem with which the applicant was concerned, in order to be relied upon as a basis for rejection of the claimed invention. See *In re Oetiker*, 977 F.2d 1443, 24 USPQ2d 1443 (Fed. Cir. 1992). In this case, all are in the field of semiconductor manufacturing utilizing photolithography and photoresists.

22. In response to applicant's argument that the examiner's conclusion of obviousness is based upon improper hindsight reasoning, it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does

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not include knowledge gleaned only from the applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971).

23. The applicant has no discussion on why new claim 30-31 would be allowable over the cited prior art.

Conclusion

24. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

25. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nicole M. Barreca whose telephone number is 571-272-1379. The examiner can normally be reached on Monday-Thursday (9AM-7PM).

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark F. Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Nicole M Barreca
Primary Examiner
Art Unit 1756



3/20/06